in FIG. 6A) are adjusted to produce a suitable fringe pattern, as observed by human eye 60, indicating the orientation of reference mirror 52 and PLZT layer 10A is precisely 90 degrees.

Then the laser light source is replaced by a white light source. A single dark fringe then will be observed if the above distances of reference mirror 52 and PLZT layer 10A from beam splitter 55 are identical to within 0.1 micron. After such a fringe is found, reference mirror 52 is adjusted to obtain a single dark fringe on PLZT layer 10A as indicated in "A" of FIG. 6B, and the reading of the micrometer adjustment of mirror 52 is noted. Then, mirror 52 is again adjusted to produce the single dark fringe on the surface of sapphire substrate 20 as shown in "B" of FIG. 6B. The difference between the two micrometer adjustment readings of the positions of reference mirror 52 is equal to the present thickness of PLZT layer 10A.

If the thickness of PLZT layer 10A is not precisely uniform, the fringe orientation will be different (for example, as in "C" of FIG. 6B) on sapphire substrate 20 than on PLZT layer 10A. If that is the case, the adjustment screws 39 can be adjusted so that as the lapping/polishing continues the pressure of PLZT layer 10A adjust lapping wheel 37 is greatest where the most PLZT material needs to removed so the thickness will be precisely uniform at the end of the lapping and polishing process. One skilled in the art can interpret the observed fringe pattern to determine when the thickness of PLZT layer 10A is uniform, and when the thickness is not uniform, one skilled in the art can readily determine how much to adjust the tilt of piston 34 within jig 36 by adjusting screws 39. The process could be accomplished under computer control in a manufacturing environment to interpret the fringe pattern and, if necessary, adjust the piston tilt for further polishing.

The above technique, by providing PLZT layers in the 5–15 micron thickness range, is a practical way of fabricating PLZT substrates of precisely the thickness needed to achieve the minimum operating voltage at the low point "A" of the PLZT operating voltage versus PLZT thickness curve of FIG. 8.

More complex spatial light modulator structures then can be formed by vertically "stacking" such two-dimensional spatial light modulators one on top of the other, as shown in FIG. 7. For example, in FIG. 7 two two-dimensional spatial light modulators 47 and 48 are vertically stacked, with a deposited layer of transparent insulating material 45 separating the electrodes 22 of spatial light modulator 47 from those of spatial light modulator 48. Numeral 50 indicates light rays passing through a particular pixel, the width of which is indicated by arrow 17. Each of the spatial light modulators 47 and 48 can be similar or identical to the one described with reference to FIG. 2, and the same reference numerals are used in FIG. 7 as in FIG. 2 to designate various parts. Different voltages can be applied to the various electrodes to "address" or "select" various spatial light modulator cells to influence the individual control of the various "pixels" or "voxels" of the complex spatial light modulator.

There are numerous ways to address a two dimensional array of cells. The most prevalent, which is employed in LCD displays is known as active matrix display (AMD). In such a system, the individual cells are designated by their x and y (column and row addresses. Part of the activation voltage is placed on each of the x and y lines aind a transistor which is unique to each cell is activated by the sum of the x and y voltages, but not by any individual x or y voltage. Such transistor then provides the desired activation vfoltage and holds that voltage until that cell is again addressed in a subsequent writing cycle.

FIG. 5 illustrates another spatial light modulator structure of the present invention, in which both positive and negative electrodes 11–14 are formed on the top surface 15A, just as in the prior art structure shown in FIG. 1. However, in FIG. 1, transparent electrodes 31 and 32 are formed on the bottom surface of thin PLZT layer 10A. (For convenience, the thick transparent substrate on which PLZT layer 10A is attached is not shown.)

The voltages applied to bottom electrodes 31 and 32 in FIG. 5 can "modulate" the fringing fields 15 in FIG. 5. For example, a sufficiently positive voltage applied to transparent electrode 31 "enhances" or strengthens the fringing field 15 as shown, producing a strong modulating effect by increasing the intensity of the fringing fields 15. On the other hand, a negative voltage applied to one of the transparent bottom electrodes, for example electrode 32, has the effect of "retarding" or suppressing the fringing field above it. In the example of FIG. 5, fringing field 15X is retarded by the (−) voltage applied to transparent electrode 32.

This feature gives added flexibility in providing x and y select capability to allow convenient x,y addressing of individual pixels iii an array of spatial light modulator cells.

While the invention has been described with reference to several particular embodiments thereof, those skilled in the art will be able to make the various modifications to the described embodiments of the invention without departing from the true spirit and scope of the invention. It is intended that all combinations of elements and steps which perform substantially the same function in substantially the same way to achieve the same result are within the scope of the invention.

What is claimed is:

1. A spatial light modulator comprising in combination:

(a) a thin layer of solid-state electro-optical material having parallel, opposite first and second surfaces;

(b) a first electrode disposed on the first surface;

(c) a second electrode disposed on the second surface and laterally displaced relative to the first electrode to thereby produce a lateral electrical field component in the laver in response to a difference between control voltages applied to the first electrode and the second electrode, respectively; and

(d) a pixel region in the electro-optical material between a portion of the first electrode and a portion of the second electrode, light selectively passing through the pixel region in response to the difference between the control voltages applied to the first electrode and the second electrode, respectively.

2. A spatial light modulator comprising in combination:

(a) a thin layer of solid-state electro-optical material having parallel, opposite first and second surfaces;

(b) an elongated first electrode disposed on the first surface and generally oriented in a first direction;

(c) a plurality of spaced, elongated second electrodes disposed on the second surface and generally oriented in a second direction, each second electrode being laterally displaced relative to a nearest portion of the first electrode to thereby produce a lateral electrical field component in the laver in response to differences between control voltages applied to the first electrode and to the plurality of second electrode, respectively; and

(d) pixel regions in the electro-optical material between portions of the first electrode and portions of the second

electrodes, light selectively passing through the pixel regions in response to the differences between the control voltages applied to the first electrode and the plurality of second electrodes, respectively.

3. The spatial light modulator of claim 2 wherein the solid-state electro-.ptical material is PLZT.

4. The spatial light modulator of claim 3 wherein the layer of solid-state electro-optical material has a thickness which results in a minimum activation voltage of the spatial light modulator.

5. The spatial light modulator of claim 4 wherein the layer of solid-state electro-optical material has a thickness in the range of approximately 5 to 15 microns.

6. The spatial light modulator of claim 2 including a transparent substrate attached to the second surface.

7. A spatial light modulator comprising in combination:

(a) a thin layer of solid-state electro-optical material having parallel, opposite first and second surfaces;

(b) an elongated first electrode disposed on the first surface and generally oriented in a first direction;

(c) a plurality of spaced, elongated second electrodes disposed on the second surface and generally oriented in a second direction; and

(d) pixel regions in the electro-optical material between portions of the first electrode and portions of the second electrodes, light selectively passing through the pixel regions in response to differences between control voltages applied to the first electrode and the plurality of second electrodes, respectively,

wherein the first electrode is of serpentine shape, pixel-defining first portions of the first electrode being oriented in the second direction, second portions of the first electrode between the first portions being oriented in the first direction.

8. A spatial light modulator comprising in combination:

(a) a thin layer of solid-state electro-optical material having parallel, opposite first and second surfaces;

(b) an elongated first electrode disposed on the first surface and generally oriented in a first direction;

(c) a plurality of spaced, elongated second electrodes disposed on the second surface and generally oriented in a second direction; and

(d) pixel regions in the electro-optical material between portions of the first electrode and portions of the second electrodes, light selectively passing through the pixel regions in response to differences between control voltages applied to the first electrode and the plurality of second electrodes, respectively,

wherein the solid-state electro-ontical material is PLZT,

wherein the layer of solid-state electro-optical material has a thickness which results in a minimum activation voltage of the spatial light modulator,

wherein the layer of solid-state electro-optical material has a thickness of approximately 8 microns.

9. A spatial light modulator comprising in combination:

(a) a thin layer of solid-state electro-ontical material having parallel, opposite first and second surfaces;

(b) an elongated first electrode disposed on the first surface and generally oriented in a first direction;

(c) a plurality of spaced, elongated second electrodes disposed on the second surface and generally oriented in a second direction; and

(d) pixel regions in the electro-optical material between portions of the first electrode and portions of the second electrodes, light selectively Passing through the pixel regions in response to differences between control voltages applied to the first electrode and the plurality of second electrodes, respectively,

wherein the first electrode is of serpentine shape, pixel-defining first portions of the first electrode being oriented in the second direction, second portions of the first electrode between the first portions being oriented in the first direction,

the spatial light modulator further including a plurality of thin layers of insulator material disposed on the first surface between the second portions of the first electrode and the electro-optical material.

10. The spatial light modulator of claim 9 wherein the first direction is perpendicular to the second direction.

11. The spatial light modulator of claim 9 including a plurality of the first electrodes, the first electrodes and the second electrodes defining a rectangular array of pixel regions.

12. The spatial light modulator of claim 9 wherein the second electrodes are straight.

13. A method of controlling flow of light through a spatial light modulator, comprising the steps of:

(a) providing a first electrode on a first surface of a thin layer of solid-state electro-optical material, and a second electrode on a second surface of the layer, a portion of the first electrode and a portion of the second electrode bounding a pixel region through which light selectively passes in response to a difference between control voltages applied to the first electrode and the second electrode, respectively; and

(b) applying a voltage difference of less than approximately 50 volts between the first electrode and the second electrode to allow Light incident on the spatial light modulator to pass through a pixel region located between the first electrode and the second electrode.

14. A method of controlling flow of light through a spatial light modulator, comprising the steps of:

(a) providing an elongated first electrode on a first surface of a thin layer of solid-state electro-optical material, and a plurality of spaced, elongated second electrodes on a second surface of the layer, portions of the first electrode and portions of the second electrodes bounding pixel regions through which light selectively passes in response to differences between control voltages applied to the first electrode and the plurality of second electrodes, respectively; and

(b) applying a voltage difference of less than approximately 50 volts between the first electrode and at least one of the second electrodes to allow light incident on the spatial light modulator to pass through a pixel region bounded by a portion or portions of the first electrode and at least one of the second electrodes, and simultaneously applying a voltage difference of less than approximately 50 volts between the first electrode and the remaining ones of the second electrodes to prevent the incident light from flowing through pixel regions bounded by a portion or portions of the first electrode and the remaining ones of the second electrodes.

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